SECTION 6 SEDIMENT MANAGEMENT ALTERNATIVES – INTRODUCTION & GENERAL OVERVIEW

6.1 INTRODUCTION

This section discusses the various sediment management alternatives considered for the reservoirs and debris basins under the jurisdiction of the Flood Control District. Sediment management alternatives are organized in the following categories based on the different phases of the cleanout process.

1. Staging and Temporary Sediment Storage Areas (Section 6.2)
2. Sediment Removal Alternatives (Section 6.3)
3. Transportation Alternatives (Section 6.4)
4. Placement Alternatives (Section 6.5)

Each sediment management alternative is discussed independently. For example, discussion of dry excavation only includes the impacts it has on the facility from which the sediment is removed and the cost of performing dry excavation; it does not include the impacts or cost of transporting or placing the excavated sediment. The impacts and costs of potential staging and storage area alternatives, transportation alternatives, and placement alternatives are discussed separately in their respective sections.

The discussion of each alternative is organized as shown below.

- General Description
- Assumptions
- Environmental Impacts
  - Habitat
  - Water Quality
  - Water Conservation
  - Air Quality
- Social Impacts
  - Traffic
  - Noise
  - Aesthetic
  - Recreation
- Implementability
  - Right of way issues
  - Technical certainty
  - Permitting concerns
- Performance
  - Ability to meet the needs of the reservoirs and debris basins and maintain proper operation
  - Capacity, transport, or removal rate, as applicable
- Cost
  - Order of magnitude 20-year cost estimate
- Conclusion
  - General feasibility for large reservoirs, small reservoirs, and debris basins.

The cost estimates used in this Strategic Plan are based on historic sediment removal projects completed by the Flood Control District, discussion with industry, and additional research.

Discussion of each alternative includes applicability to the three general categories of facilities – large reservoirs, small reservoirs, and debris basins. As mentioned in Section 2 and shown in Table 6-1, the reservoirs were categorized into large and small reservoirs based on a combination of their capacity and the presence of a standing pool. In general, large reservoirs are operated with a permanent pool of water while small reservoirs are operated dry. Debris basins are significantly different from both large and small reservoirs. Debris basins do not have a pool of water, are typically cleaned in response to an immediate need to remove material between storms, and typically generate significantly less sediment than the reservoirs.

6-1 General Categories of Reservoirs

Large Reservoirs		Small Reservoirs
San Gabriel River Reservoirs	*Other Large Reservoirs*	
Cogswell	Big Tujunga	Big Dalton
San Gabriel	Devil's Gate	Easton
Morris	Pacoima	Live Oak
	Puddingstone	Puddingstone Diversion
	San Dimas	Thompson
	Santa Anita	

The discussion and conclusions presented in Section 6 provide the basis for which alternatives are considered for each reservoir and the debris basins. Sections 7 through 10 go into more specifics based on location, impacts, and costs. Combinations of alternatives are also considered.

6.2 STAGING AND TEMPORARY SEDIMENT STORAGE AREAS

Depending on the mode of transportation and destination of sediment, it could be necessary to change transportation modes; this would require a staging area in order to transfer the sediment from one mode of transportation to the other. During sediment management operations, it could be beneficial to temporarily store sediment removed from a facility to be able to gradually transport the sediment to its final destination. An example of a staging area could be an area near a reservoir used to transfer sediment from a conveyor belt to trucks. Another example is a downstream basin being used for dewatering of sluiced sediment with the basin serving as a temporary sediment storage area. The potential impacts of using a staging or temporary sediment storage area are specific to the site and can be found within the reservoir-specific sections (Sections 7 through 9). Staging and temporary sediment storage areas are not typically required for sediment management operations for debris basins.

6.3 SEDIMENT REMOVAL ALTERNATIVES

Section 6.3 discusses sediment removal by means of dry excavation, dredging, flow-assisted sediment transport, and sluicing.

6.3.1 DRY EXCAVATION

Dry Excavation - General Description

As the name implies, dry excavation requires that the material be mostly dry. For reservoirs that do not have a standing pool of water and debris basins, this requirement does not present an issue. This can also be true for reservoirs that are operated with a standing pool of water, if only the dry part of the reservoir is to be excavated. However, in order to excavate the material closest to the dam, a reservoir that has a pool of water would need to be completely drained. Material accumulated closest to the dam presents the greatest potential to inhibit operations.

Dry excavation of sediment involves the use of conventional excavation equipment such as excavators, backhoes, scrapers, bulldozers, and front-end loaders, as shown in Figure 6-1. As a result, vehicular access to the site is required for dry excavation.

Dry Excavation – Environmental Impacts

Figure 6-1 Equipment used during dry excavation

Many debris basins and reservoirs are maintained free of vegetation or habitat; however, some contain significant types or amounts. Within reservoirs, there may also be aquatic habitat. Habitat or vegetation that exists within debris basins and reservoirs could be impacted by dry excavation activities. Additionally, draining of a reservoir could impact the habitat in the stream below the dam unless measures are taken to prevent sediment from entering the stream (flow can typically be bypassed thru the work area or best management practices (BMPs) can be utilized to filter or settle out the debris from the discharged flow). Habitat within the impacted facilities is considered in order to avoid, minimize, or mitigate impacts to plant and wildlife species.

Excavation of sediment from reservoirs and debris basins can be planned ahead to minimize impacts on water conservation. While some losses are expected, most of the water released while draining a reservoir is able to be captured and recharged in downstream facilities, resulting in minimal impact to water conservation quantities.

Emissions from heavy equipment during excavation would minimally affect air quality.

Dry Excavation – Social Impacts

Dry excavation occurs within a reservoir or debris basin itself. For the excavation portion alone, there is no increase in traffic in the area surrounding the facility.

For reservoirs in a remote location, excavation operations are not expected to affect the viewshed of any residences. However, in those cases that a reservoir or debris basin is in close proximity to residences or areas visited by recreational users, excavation activities could have visual and noise impacts.

Recreational uses are not permitted at the majority of the reservoirs and all of the debris basins under the jurisdiction of the Los Angeles County Flood Control District. Therefore, for the most part, dry excavation does not impact recreational resources, but such impacts are identified in cases where it would create an impact. In any case, draining of a reservoir in anticipation of excavation activities could potentially impact recreational resources downstream .

Dry Excavation - Implementability

The Flood Control District has conducted numerous sediment removal projects at reservoirs and debris basins using conventional dry excavation equipment and techniques. Given the Flood Control District's experience, excavating sediment from the reservoirs and debris basins under dry conditions is a technically certain method of sediment removal.

As previously mentioned, some reservoirs are operated with a pool of water. For a given reservoir, this could be due to operational concerns, the reservoir's function in the management of flood risk, the reservoir's function in water conservation, or a combination of these reasons. In order not to interfere with a reservoir's operational needs and functions and to minimize hazards to workers, reservoirs are typically drained and excavated outside of the storm season, namely between April 16th and October 14th. However, it could be possible to excavate some material outside of these dates if conditions permit.

Draining of a reservoir is limited by the discharge capacity of the dam's outlets and habitat or stakeholder interests downstream of the reservoir. The time needed to drain the reservoir and get the sediment in the reservoir to an appropriate dryness could limit the time available to excavate sediment from the reservoir.
Given the relative small size of most debris basins and absence of a standing pool, excavation of sediment from debris basins is conducted outside of the storm season without major delays due to dewatering. For debris basins in burned watersheds, excavation of sediment is often completed both before and during the storm season.

Excavation of sediment from reservoirs and debris basins within Flood Control District property does not present right of way concerns, but requires environmental regulatory permits.

Dry Excavation - Performance

The Flood Control District has effectively used dry excavation to remove sediment from reservoirs and debris basis in the past. While there may be other issues, the effectiveness of dry excavation is not a concern for future cleanouts.

Bulldozers, loaders, and excavators used for dry excavation are among the most commonly used earthmoving machines. It is expected that excavation operations would be able to match the efficiency of any mode of transportation being considered.

Dry Excavation – Cost

The cost to excavate sediment from a reservoir is approximately $3 per cubic yard. Due to the smaller size of debris basins, the cost to excavate sediment is approximately $7.50 per cubic yard. These costs do not include the cost of transporting or placing sediment.

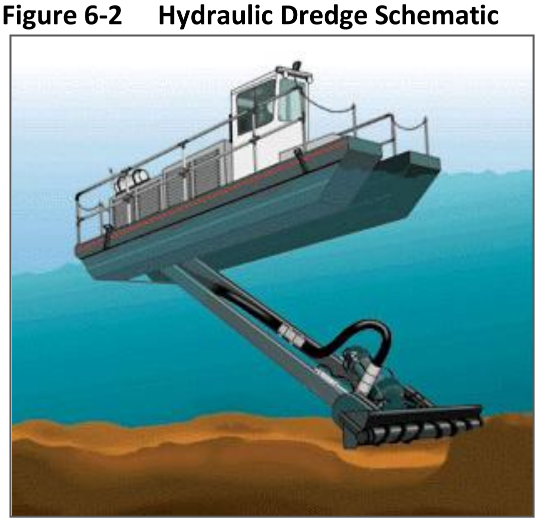
Dry Excavation – Conclusion

☑	Large reservoirs
☑	Small reservoirs
☑	Debris basins

Dry excavation is a sediment removal method that could be feasible at reservoirs, both large and small, and at debris basins.

6.3.2 DREDGING

Figure 6-2 Hydraulic Dredge Schematic



Dredging - General Description

Dredging is a type of underwater excavation that is used to remove sediment from a large water body. Generally dredges either scoop or suction sediment, along with water, from the bottom of a water body. The San Gabriel and Morris Reservoirs Dredging Feasibility Study (2000) completed for the Flood Control District indicates the cutterhead suction dredge would be the most practical type of dredge for the reservoir cleanouts. This plan assumes that to still be the case.

Since dredges are designed to be used under water, dredging could not be employed in reservoirs that do not have a pool of water. Dredging is also not a feasible method to remove sediment from debris basins due to both the lack of water and the size of debris basins. Therefore, this section discusses the potential impacts of dredging those reservoirs that usually have a pool of water.

Dredging - Assumptions

The following list presents the assumptions made and taken into account while analyzing dredging as a method to remove sediment from the reservoirs.

- A portable hydraulic cutterhead dredge would be used.
- The dredge would be able to remove sediment at a maximum water depth of approximately 50 feet.
- The dredge would be able to handle only the smaller material in the reservoir. Therefore, sediment from portions of the reservoir with the larger material would need to be removed using a different method.
- The dredge would be able to remove approximately 200 cubic yards of sediment per hour.
- The water-sediment mixture suctioned by the dredge would have a water-sediment ratio of approximately 9 to 1. Therefore, the dredge would have a total discharge of approximately 2,000 cubic yards per hour or 15 cubic feet per second of the sediment/water mixture.
- The dredge would be connected to a 12-inch high-density polyethylene (HDPE) slurry pipeline. (Impacts associated with the use of slurry pipelines are discussed in Section 6.4.4)
- For every 100,000 cubic yards of sediment dredged, a dewatering site of approximately 40 acres would be required to drain the dredged material.
- If a dewatering site is unavailable, a mechanical dewatering machine could be employed to dewater the sediment. It would then place the dried sediment in a barge or onto a floating conveyor belt to be tranported to the shore for transport to a placement site. However, dewatering machines are very slow and may impact dredging performance.
- Turbidity concerns could be partially mitigated with a silt curtain around the dredge. The curtain acts as a wall to prevent silt from moving beyond the curtain.
- Generally dredging operations would only be able to be conducted six months out of the year because of the need to provide flood protection and water conservation. This limits the water depth and the need for a dewatering area. In wet years, the available timeframe may be less, as it may take longer to drain the resrvoir to acceptable levels.
- The dredge would be operated only on weekdays, during two eight-hour shifts, for a total of 16 hours per weekday.
- Dredges could discharge directly to the stream below the dam during the storm season and storm flows could flush the sediment downstream reducing impacts to the habitat in the streamcourse. However, the sediment laden flows would be inappropriate for groundwater recharge, as the suspended sediment in the flows will clog downstream spreading facilities. Also, the quantity of sediment that could be transported in the manner is very uncertain. This alternative is not considered as part of this plan, but can be looked at in the future if other methods are not feasible.

Dredging - Environmental Impacts

The potential impacts dredging would have on vegetation and fauna depends on the specifics of the habitat (above ground and underwater) within each reservoir. Existing habitat in the area(s) considered for discharge and drying of dredged material would also need to be determined.

Dredging could impact water quality within a reservoir by increasing turbidity. However, as previously noted, it is assumed that water quality concerns could be partially addressed with a silt curtain around the dredge. A silt curtain would limit the turbidly to the area within the silt curtain preventing impacts to the entire reservoir. In the past, water quality regulators have expressed high concern regarding the residual turbidity in the reservoir.

Dredging a reservoir (and transporting the dredged slurry via a slurry pipeline) could affect water conservation if the dredging rate is faster than the rate of sediment settling at the downstream facility where the dredged material is being dewatered. Overflows with suspended sediment can result in sediment deposition within the channel downstream of the dewatering area and downstream spreading facilities and could significantly impact water conservation.

Dredging - Social Impacts

Since dredging operations would occur within a reservoir itself, there would not be an increase in traffic in the area surrounding the reservoir.

For reservoirs in a remote location, dredging operations are not expected to impact the viewshed of any residences. However, for a reservoir in close proximity to residences or areas visited by recreational users, dredging activities could have visual and noise impacts.

Operating a dredge within a reservoir that serves a recreational purpose would impact recreation by limiting areas around the dredge, pipeline, and discharge locations. However, as previously discussed, the majority of the reservoirs under the jurisdiction of the Flood Control District are not accessible to the public and do not have permitted recreational uses.

Dredging - Implementability

As previously discussed, dredging can only be conducted at reservoirs with an adequate standing pool and would not present right of way concerns. While dredging is a technique that has been used in other areas of the country for decades, pilot testing would need to be completed to more accurately identify feasibility for specific reservoirs.

The use of a dredge would require environmental regulatory permits.

Dredging - Performance

Based on the previously mentioned assumptions, a 6-month dredging operation could remove approximately 400,000 CY of sediment from a reservoir. In turn, a total of approximately 4 MCY or 2,500 acre-feet of water-sediment slurry would need to be dewatered. The dredged material can be transported to the shore from the dredge via slurry pipeline, floating conveyor, or another barge.

Alternatively, dredged material could be mechanically dewatered on shore. However, the rate at which the material could be mechanically dewatered is not sufficient for the quantity of sediment the machine would be required to process. However, the rate at which a mechanical dewatering machine can dry sediment is slow and cannot likely meet the need of the large quantities to be removed from the reservoirs.

Dredging – Cost

Dredging, including operating costs, would cost approximately $10.50 per cubic yard of sediment dredged. Employing a mechanical dewatering machine would cost an additional $34.50 per cubic yard. These costs do not include the cost of transporting and placing sediment.

Dredging – Conclusion

☑	Large reservoirs
☒	Small reservoirs
☒	Debris basins

Dredging is a removal alternative that could be feasible at large reservoirs, which have a pool of water. However, it is not feasible at small reservoirs, which do not have a pool of water or at debris basins.

Mechanically dewatering material is not feasible for any dredging operations due to the low efficiency and high cost. It is not considered further as part of this Strategic Plan.

6.3.3 FLOW-ASSISTED SEDIMENT TRANSPORT & SLUICING (AS A REMOVAL METHOD)

6.3.3.1 FLOW-ASSISTED SEDIMENT TRANSPORT

Flow-assisted sediment transport (FAST) takes advantage of water flows to minimize sediment deposition and slow down the rate of sediment accumulation.

Due to the insufficiency of flows needed to perform FAST at debris basins, this alternative is not feasible for those types of facilities.

At dams with sufficient water flow, FAST would involve operating the dam in a manner that facilitates movement of sediment through the valves during rainfall events, thus mimicking natural processes. There is still a high degree of uncertainty surrounding the FAST alternative in regards to flow availability and impacts to downstream facilities and the environment. Operations will need to be considered and evaluated based on the impacts.

Figure 6-3 Open valve discharging flow

FAST – Conclusion

⃠	Large reservoirs
⃠	Small reservoirs
☒	Debris basins

Due to the high degree of uncertainty surrounding FAST and the conceptual-level of this Strategic Plan, FAST is not considered further as part of this Strategic Plan. It is recommended this alternative be evaluated in the future for both large and small reservoirs. FAST is not feasible for debris basins.

6.3.3.2 SLUICING (AS A REMOVAL METHOD)

This section focuses on sluicing as a sediment removal method and discusses the impacts of sluicing within a reservoir only. For the impacts of sluicing downstream, see Section 6.4.1.

Sluicing (Removal) - General Description

Sluicing is a sediment removal method that employs water flow to remove smaller-particle sediment (i.e., sands and silts). Sluicing involves draining a reservoir to expose the accumulated sediment to incoming water flows so that the water can resuspend the sediment and carry it through the dam's sluice gate or valves. Typically, the sediment-laden water is captured in a reservoir or other facility downstream that is more accessible for sediment removal operations than the reservoir from which sediment was sluiced. Figure 6-4 shows the channel cut by the water in the sediment at the upstream of Morris Reservoir.

Sluicing (Removal) – Assumptions

Figure 6-4 Sluicing event at Morris Reservoir

The following list presents the assumptions made and taken into account while analyzing sluicing as a method to remove sediment from the reservoirs.

- Equipment (e.g., bulldozers) would be used in the reservoir to push sediment into the water flowing through the reservoir in order to optimize sediment transport and removal from the reservoir.
- The sediment-laden water leaving the reservoir would have a water-sediment ratio of approximately 9-to-1.

Sluicing (Removal) - Environmental Impacts

Impacts from sluicing operations on biological resources within the reservoir would vary, depending on whether the reservoir has a pool year-round. Sluicing operations typically occur after reservoir inundation periods, so there usually is not vegetation within the areas in which equipment would be pushing sediment into the sluiceway. However, this would not be the case for a reservoir that is kept dry, except for storm periods; such a reservoir could have vegetation that would be impacted.

Water quality within the reservoir would not be impacted by sluicing operations since no significant amounts of water would remain in the reservoir after draining it. The only water within a reservoir that is being sluiced would be water flow entering and passing through the reservoir.

Dewatering a reservoir in order to sluice could affect water conservation if the water is released faster than downstream spreading facilities can handle. Furthermore, some of the silt resuspended in the water during dewatering and sluicing can deposit in the channel and affect water conservation efficiency. This is discussed further in Section 6.4.1, which discusses the impacts along the channel downstream of the reservoir.

Sluicing operations within a reservoir would result in equipment emissions. However, based on experience from the Flood Control District's previous sluicing projects, only a few pieces of equipment would be necessary within the reservoir. Therefore, air quality impacts would not be significant.

Sluicing (Removal) - Social Impacts

The social impacts of removing sediment from a reservoir by sluicing are the same as the social impacts associated with dry excavating and dredging a reservoir (Again, this section focuses on the impacts within or in the proximity of a reservoir). Sluicing activities within a reservoir would not impact traffic or recreational resources. Visual and noise impacts would be experienced by those in proximity of the reservoir.

Sluicing (Removal) - Implementability

The ability to remove sediment from a reservoir by sluicing will be dependent on inflow into the reservoir, which is entirely dependent on the weather or, in the case of San Gabriel and Morris Reservoirs, on an upstream reservoir. Large reservoirs with watersheds that can deliver sufficient inflow during the summer and fall seasons would be sluiced during the summer and fall. Reservoirs with watersheds that deliver inflow only during and immediately after storms would be sluiced during the storm season when safety allows. Typically, sluicing operations occur during or after very wet storm seasons. In addition to inflow, another factor that limits sluicing is the availability of temporary sediment storage areas and the rate at which they can receive the sluiced water-sediment mixture.

Similar to the other methods of sediment removal already discussed, environmental regulatory permits would be needed.

Given that numerous sluicing projects have been conducted in the past by the Flood Control District, sluicing sediment from reservoirs is a technically certain method of sediment removal.

Sluicing (Removal) - Performance

The time required to sluice a given amount of sediment out of a reservoir depends on the inflow into the reservoir and the entrainment of sediment into the water stream as it travels through the reservoir. Typically, sluicing operations occur during or after very wet storm seasons. Based on historical records, the Flood Control District has been able to remove between 150,000 to 2,600,000 CY of sediment in a given sluicing season, depending on the reservoir and the wetness of the storm season during or preceding the sluicing operation.

Sluicing (Removal) – Cost

The cost of sluicing sediment from a reservoir is approximately $2.50 per cubic yard. This does not include costs associated with transporting to and removal from the temporary sediment storage areas or for final placement.

Sluicing (Removal) – Conclusion

☑	Large reservoirs
☒	Small reservoirs
☒	Debris basins

Sluicing as a removal alternative could be feasible at large reservoirs that typically have enough inflow during the dry season. However, it is not feasible at small reservoirs or debris basins, which do not have sufficient flows needed to sluice.

6.4 TRANSPORTATION ALTERNATIVES

Section 6.4 discusses transportation of sediment removed from the reservoirs and debris basins by means of sluicing, trucking, conveyor belt, slurry pipeline, rail, two-way salt water pipeline, and cable bucket system.

6.4.1 SLUICING (AS A TRANSPORTATION METHOD)

Sluicing involves using flow water to carry sediment suspended in it. This section focuses on the impacts sluicing has on the waterways downstream of the reservoirs. For the impacts of sluicing within a reservoir, refer to Section 6.3.3.2.

Figure 6-5 Channel flowing with sediment laden flow

Sluicing (Transportation) - Environmental Impacts

Impacts from sluicing operations on biological resources below the dam would vary, depending on whether the watercourse below the dam contains significant aquatic resources. Some reservoirs contain significant fish and amphibian life and habitat downstream of them while others do not. Riparian vegetation could be positively impacted due to the nutrients provided by the sluiced sediment.

Sediment is transported from a reservoir to another facility downstream by sluicing. Some of the resuspended silt deposits in the channel and affects water conservation in two ways. In the case of the San Gabriel River, which has detention basins within the river for groundwater recharge, deposits would lower percolation rates. In other channels, deposits can remain in the channel, resuspend with future flows, and possibly make it to downstream recharge facilities, causing percolation rates in the recharge facilities to decrease. Flushing the channel after sluicing helps to remove deposits and decrease the impact on groundwater recharge; however, the ability to do so is highly dependent on the availability of base flows or water from upstream reservoirs.

Sluicing (Transportation) - Social Impacts

If waterways have permitted recreation uses such as fishing and swimming, recreation would be impacted. There would be visual impacts along the channel as the flows would not be clear. Additionally, there could be odor impacts and a temporary rise in insects near the channel.

Sluicing (Transportation) - Implementability

Environmental regulatory permits would be needed to sluice sediment along the waterways downstream of the reservoirs. Some of the sediment will settle in the waterway as sediment-laden water travels downstream. Sediment that deposits downstream could reduce the hydraulic capacity of the channel. Such sediment could need to be removed by flushing or mechanical means. Environmental regulatory permits would be needed to remove sediment from the waterways.

The ability to transport sediment by sluicing is affected by a channel's slope and other characteristics. In channels that are relatively flat, there would be more sediment deposition than in steeper channels. Therefore, a channel's grade and other characteristics need to be considered.

Sluicing (Transportation) - Performance

Sediment will settle as sediment-laden water travels downstream. Heavy equipment could be used to manage sediment deposition and, if necessary, remove the deposited sediment within the waterway. The sluiced sediment traveling through portions of lined channels can be highly erosive, increasing the need for maintenance and repairs.

Sluicing (Transportation) - Cost

As mentioned previously, the cost for sluicing is approximately $2.50 per cubic yard. This does not include costs associated with transporting to and removal from the temporary sediment storage areas or for placement.

Sluicing (Transportation) – Conclusion

☑	Large reservoirs
☒	Small reservoirs
☒	Debris basins

Sluicing as a transportation alternative is a transportation alternative that in this Strategic Plan is exclusively associated with sluicing as a removal alternative. Therefore, its feasibility for the different types of facilities is the same as for sluicing as a removal alternative.

6.4.2 TRUCKING

Trucking is a transportation method that is suitable for generally dry material and has been used extensively by the Flood Control District to transport sediment from reservoirs and debris basins. In the past, standard trucks have been used along regular roadways. However, the following sections include discussion of low-emission trucks as well as trucking in channels.

6.4.2.1 TRADITIONAL & LOW-EMISSION TRUCKING

Trucking – General Description

Using trucks to transport sediment from reservoirs and debris basins involves the use of single-dump and double-dump trucks.

The impacts associated with employing traditional or low-emission trucks would be the same, except for the impact on air quality. While it is possible that low-emission trucks are not currently available in the quantities needed, it is expected that the size of the low-emission truck fleet accessible to the Flood Control District will increase in the years to come.

Trucking – Assumptions

The following list describes the general assumptions made and taken into consideration while analyzing trucking as a method to transport sediment from the reservoirs and debris basins.

- A single-dump truck would handle approximately 8 CY of sediment per trip while a double-dump truck would handle approximately 16 CY of sediment.
- Trucks would average a speed of 15 to 30 miles per hour, and possibly faster depending on the route.
- For trucking operations from reservoirs, approximately 400 truck loads would be transported per day. For operations from debris basins, the number of truck loads would differ depending on the time to load the trucks.
- Trucking operations that are part of sediment removal projects at reservoirs and non-emergency debris basin cleanouts (that is, for debris basins in non-burned watersheds or have not been impacted by a major storm) would generally be conducted during weekdays for eight hours per day. Each trucking operation at a reservoir would last approximately six months.
- Trucking operations that are part of emergency debris basin cleanouts (that is, for a debris basin in a burned watershed with little time in between storms, or has been impacted by a major storm and the storm season has not yet ended) could possibly include operations during the weekend and around the clock work hours. The duration of such trucking operations would depend on the quantity of sediment to be removed.
- Trucking impacts can be reduced in some instances by stockpiling the sediment oustide of the dam or debris basin and then trucking it at a reduced rate for a longer period of time. This involves double handling of the material and less efficient operations which increases cost.

Figure 6-6 Excavation equipment loading single dump trucks

Trucking – Environmental Impacts

If existing roads are used, no particular impacts would be expected on habitat and water quality. However, if new or temporary roads are used, there would be habitat impacts and potentially water quality impacts associated with the construction and use of those routes.

The use of low emission trucks would result in lower air quality impacts than if standard trucks were used. The Flood Control District will consider opportunities to employ low emission trucks.

Trucking – Social Impacts

Employing trucks could significantly impact traffic. This is especially true along two-lane roads in and out of the remote locations where some of the reservoirs are located. The same would be true along residential streets in the neighborhoods where debris basins are located. Additionally, employing trucks could result in above-normal pavement wear.

Depending on the route and the vicinity along the route, trucking could impact recreational resources with the increase in traffic. Route selection would consider avoidance of neighborhoods and schools, traffic impacts, and trucking efficiency, among other issues. New or temporary roads in some locations would help alleviate some of the social impacts. Heavy truck traffic can also impact pavement which could lead to more re-paving projects, which would also have social impacts.

Trucking – Implementability

Some cities require trucking permits, but if truck routes were able to remain entirely on existing public roads, no right of way concerns would be expected. On the other hand, if new or temporary roads are used, right of way and possibly environmental issues woud need to be addressed.

Trucking – Performance

A six-month long trucking operation, at one location, that utilizes single-dump trucks can transport approximately 400,000 CY of sediment while one that utilizes double-dump trucks can transport approximately 800,000 CY.

Trucking – Cost

The cost of employing single dump trucks is approximately $0.65 per cubic yard per mile traveled. The cost of employing double-dump trucks is approximately $0.30 per cubic yard per mile traveled. This does not include the cost for removing or placing sediment.

Trucking – Conclusion

☑	Reservoirs
☑	Small reservoirs
☑	Debris basins

Trucking is transportation alternative that could be feasible for sediment removed from reservoirs and debris basins. Wherever it is feasible to use trucks, employment of low-emission trucks will be considered to reduce air quality impacts.

6.4.2.2 TRUCKING IN CHANNELS

Trucking in Channels - General Description

This method would be similar to trucking alternatives described in the previous section. However, portions of the haul route could include driving within the existing network of concrete-lined flood control channels instead of traveling on roadways.

Figure 6-7 Typical Rectangular Channel

Trucking in Channels - Environmental Impacts

The environmental impact associated with trucking in channels would be similar to other trucking methods, except for potential impacts to water quality for the stream course within the channel. Depending on the specific location, best management practices could be employed to reduce impacts by avoiding contact with the water and reducing the introduction of pollutants through fluid leaks from the trucks. Noise and emissions may be impacted to residents or businesses adjacent to the channels.

Trucking in Channels - Social Impacts

Depending on the location, rerouting truck traffic through channels could reduce traffic impacts on to communities through which the trucks need to travel. Noise could increase or decrease for residents in the vicinity, depending on the location of their house compared to the channel and the street.

Trucking in Channels - Implementability

While this method seems reasonable at first glance, two major concerns severely limit its implementability and consequently it is not considered a feasible alternative. First, in areas where social impacts could be avoided by use of this method, the relatively narrow channel widths and low bridge clearances make it so trucks cannot travel within the channels. Channels increase in size further downstream, but arterial roadways and freeways typically become available for truck traffic, reducing the social benefits achieved by trucking within the channels. Second, the heavy, repetitive loads produced by the trucks have been shown in the past to severely degrade the concrete inverts (bottom) of the channels. This was experienced in the Los Angeles River during the Los Angeles County

Drainage Area (LACDA) improvements in the 1990s. Because of these obstacles and the tremendous cost to implement significant infrastructure modifications necessary to accommodate trucks in the channels, this methodology in not currently feasible.

Trucking in Channels - Performance

For the very few, if any locations, where this method could be employed without major infrastructure modifications, its use would also be limited to the dry season. Other than this issue, performance is not expected to be a concern if the issues with implementability and social impacts can be overcome.

Trucking in Channels - Cost

New access ramps and modification to the channel bottom to allow for truck loading would significantly increase the cost compared to trucking along roadways. Costs would vary with the specific location and project.

Trucking in Channels – Conclusion

☒	Large reservoirs
☒	Small reservoirs
☒	Debris basins

Given the limited implementability and performance of trucking in channels, this transportation method will no longer be considered for future Flood Control District sediment removal projects.

6.4.3 <u>CONVEYOR BELT</u>

Conveyor Belt – General Description

This could involve the permanent or temporary installation of conveyor belt systems or the use of existing conveyors as a potential transportation alternative for sediment that has been excavated or that needs to be transported from a temporary sediment storage area to another site.

Generally, conveyor belts are not being considered for use at debris basins given the small quantity of sediment.

Figure 6-8 Conveyor Belt System

Excavators load the sediment on a hopper (top left), then the sediment is transported via conveyor belt (top right & bottom left) and eventually placed at a placement location (bottom right).

Conveyor Belt – Assumptions

- Conveyors with a minimum 42-in conveyor width would be used.
- A conveyor efficiency of approximately 800 CY of sediment per hour and 8 hours of operation per day, which result in the movement of approximately 6,400 CY (or approximately 10,000 tons) of sediment per day.
- Conveyor operations would last approximately six months during a given year since that is the approximate number of months that sediment can be excavated out of the reservoir.

Conveyor Belt – Environmental Impacts

In order to identify and minimize the potential impacts of a conveyor operation, the habitat along the potential conveyor alignment would have to be studied. If the conveyor could be placed along existing roads, impact on habitat would be expected to be minimal. Water quality and groundwater recharge would not be expected to be impacted.

If the conveyors were to be electrically powered, air quality would only be impacted by fugitive dust as sediment is transported on the conveyor belts or as it passes through a hopper between conveyor belts. However, moisture levels of the sediment could help reduce fugitive dust emissions. Furthermore, enclosing the conveyor system or spraying the sediment with water would also reduce emissions. For systems located in areas where there is inadequate electrical power available, there would be additional air quality impacts from generators.

Conveyor Belt – Social Impacts

There would be some visual disturbances during the life of a conveyor operation. Also, depending on the alignment of the conveyor belt system, recreational resources could be impacted visually and physically. Finally, during the installation and removal of the conveyor belt system there could be additional noise impacts to nearby areas.

Conveyor Belt – Implementability

Depending on the alignment of the conveyor belt, right of way issues could have to be addressed. Placement of a conveyor belt across or along roads would need to ensure roadway safety issues (e.g., visibility, vehicle clearance, traffic controls) are taken into account. Use of an existing conveyor system would need to be arranged with the owner of the conveyor system.

Conveyor Belt – Performance

Based on the assumptions previously stated, approximately 800,000 CY of sediment could be moved by a conveyor belt system in a 6-month removal operation.

Conveyor Belt – Cost

The cost of a generally linear conveyor belt would be approximately $800 per linear foot. More difficult conveyors with turns and larger elevations changes would cost approximately $1,200 per linear foot. This does not include the cost for removing or placing sediment.

Conveyor Belt – Conclusion

☑	Large reservoirs
☑	Small reservoirs
☒	Debris basins

Conveyors are a transportation alternative that could be feasible for sediment removed by dry excavation from reservoirs. However, transport of sediment from debris basins on conveyors is not feasible.

6.4.4 SLURRY PIPELINE

Slurry Pipelines - General Description

Slurry pipelines would be used in conjunction with the dredging sediment removal alternative. The dredged water-sediment slurry would be pressurized and transported to its destination via the slurry pipeline.

Since dredging is not feasible at debris basins or small reservoirs, slurry pipelines are not either. Since dredging is feasible at the large reservoirs, the use of slurry pipelines to transport sediment dredged from large reservoirs may be feasible. Thus, this section focuses on the use of slurry pipelines for large reservoirs.

Slurry Pipelines - Assumptions

A detailed analysis of the sediment in the reservoirs and consequently of the slurry would be needed in order to design the slurry pipelines and define optimal operating conditions. However, for planning purposes, the following assumptions were made.

- A 12 inch high-density polyethelene (HDPE) slurry pipeline would be permanently installed and used at the frequency at which material would be dredged.
- The HDPE slurry pipeline would be flexible and able to handle sharp turning radii.
- The flow rate in the slurry pipeline would be approximately 15 cubic feet per second, based on the assumed dredge discharge mentioned previously.
- A lift station would be required for approximately every 5,000 feet of pipeline. The cost of installing and operating a lift station is approximately $1 per cubic yard of sediment moved.
- Slurry pipelines would be placed above ground.

Slurry Pipelines - Environmental Impacts

In order to identify and minimize the potential environmental impacts of placing and operating a slurry pipeline, the habitat along the potential alignments would have to be studied. No impacts are expected on water quality and air quality.

Transportation via slurry could affect water conservation if the discharge rate is faster than the sediment settling rate at the downstream facility where the dredged material is being dewatered. Overflows with suspended sediment can result in sediment deposition within the channel downstream of the dewatering area and downstream spreading facilities and could significantly impact water conservation.

Figure 6-9 Slurry Pipeline

Slurry Pipelines - Social Impacts

If placed above ground, construction of a slurry pipeline would cause some visual disturbances and temporary construction impacts. If the slurry pipeline is placed underground, it could cause visual, traffic, and recreational impacts during construction.

Slurry Pipelines - Implementability

Placement of a slurry pipeline could present both right of way and permitting issues. If a slurry pipeline is to be placed along a roadway, roadway impacts would need to be considered while determining the best alignment.

Employing slurry pipelines to transport sediment would require a discharge location where sediment can be dewatered and temporarily stored. The specifics of the required dewatering area would need to be evaluated if a slurry pipeline is to be pursued for a specific reservoir cleanout project.

Operating the lift stations along a slurry pipeline alignment would require energy. The capacity of the power grid from which the energy would be drawn would need to be evaluated if a slurry pipeline is to be employed.

Slurry Pipelines - Performance

The slurry pipeline would transport approximately 200 CY of sediment per hour, which corresponds to approximately 15 cubic feet of the slurry per second, based on the assumed limitations of a dredging operation.

This type of pipeline is also expected to perform for the 20-year planning timeline, which would result in minimal maintenance effort.

Slurry Pipelines - Cost

The cost to install and operate a slurry pipeline is approximately $37.50 per linear foot. Additionally, the cost to install a lift station would be approximately $1 per station per cubic yard moved. These costs do not include the cost for removing or placing sediment.

Slurry Pipelines – Conclusion

☑	Large reservoirs
☒	Small reservoirs
☒	Debris basins

Slurry pipelines are a transportation alternative that could be feasible for sediment removed by dredging from reservoirs. Since wet removal alternatives (dredging or sluicing) are not feasible at debris basins, slurry pipelines are not either.

6.4.5 RAIL LINES

Rail is an extremely efficient mode of transportation, but is limited by the location of its tracks. The following subsections describe the possibility of using existing rail networks or constructing new ones for the purpose of transporting material from sediment removal projects.

Figure 6-10 Train on rail lines

6.4.5.1 EXISTING RAIL LINES

Existing Rail Lines - General Description

There is a relatively extensive rail network in Southern California. Loading and unloading of rail cars can occur at sidings, where a train can “pull over” and not impact through traffic on the main line.

Existing Rail Lines - Environmental Impacts

Use of the existing rail network for transport of sediment would result in minimal air quality, habitat, and other environmental impacts.

Existing Rail Lines - Social Impacts

Additional social impacts associated with the use of the existing rail network are also expected to be very low, except for traffic and noise impacts near sidings, where loading and unloading of the rail cars could occur.

Existing Rail Lines - Implementability

Most existing sidings are associated with a specific business and require negotiation for their use. Furthermore, significant modification of sidings could be required in order to load sediment. Due to the limited locations where sidings are located, use of this alternative would be highly limited.

Existing Rail Lines - Performance

Performance of transport by rail is limited by the proximity of sidings to the origin and destination locations of the sediment. In almost all cases, trucks or some other mode would be required to transport the sediment from its source location to a siding where it could be loaded onto a rail car. Trucks would also likely be needed to transport from another siding to the final placement location.

Existing Rail Lines - Cost

Once the sediment is on the rail cars, transport by rail is relatively inexpensive at approximately $0.03 per cy-mile. However, the cost of loading and unloading the sediment increases the cost of this alternative by $10 per cubic yard. These costs do not include the cost of removing or placing sediment.

Existing Rail Lines – Conclusion

☒	Large reservoirs
☒	Small reservoirs
☒	Debris basins

Given the limited implementability and performance of existing rails, this transportation method will no longer be considered for future Flood Control District sediment removal projects.

6.4.5.2 NEW RAIL LINES

Establishing new rail lines would result in higher social and environmental impacts than any other alternative mainly due to the wide right of way that is required. Given the high social and environmental impact, the implementability of new rail lines would be very low, if at all feasible. It is also highly expensive, costing approximately $150 million per mile to acquire right of way and install.

New Rail Lines – Conclusion

Due to the combination of high social and environmental impacts, limited implementability, and expensive cost, the construction of new rails lines as a transportation method for Flood Control District sediment management projects is not considered as part of the this plan.

6.4.6 TWO-WAY SALT WATER PIPELINE

Two-Way Salt Water Pipeline - General Description

Seawater could possibly be used as a fluid for slurry transport of sediment for facilities that do not have sufficient water naturally tributary to them. It would need to be pumped to the facility from a coastal source, then mixed with sediment and returned to a coastal outfall.

Two-Way Salt Water Pipeline - Environmental Impacts

Depending on the route considered, environmental impacts would be limited to the habitat disturbed due to the installation of the two way pipeline and pump stations. Much of the pipeline could be located within existing rights of way.

The two-way salt water pipeline would require high energy usage, impact wildlife at the pumping intakes, create a higher concentration of sediment at the outfall, and modify the natural process of sediment going to the coast. The coastal intake and outfall location would have very high environmental impacts and are not considered viable options.

Two-Way Salt Water Pipeline - Social Impacts

Construction of approximately 50 miles of two-way piping, many pump stations, and an intake and outfall location will create significant traffic, noise, air quality, and visual impacts.

Two-Way Salt Water Pipeline – Implementability

This alternative is not feasible due to implementability concerns. For example, to serve one reservoir in the San Gabriel Mountains, 10 cfs of seawater would need to be pumped over 1,000-feet in elevation for distance of approximately 50 miles, which totals approximately 15,000 feet in dynamic head. This would require at least 15 pump stations along the route, along with custom made piping and flanges due to the high pressure and require booster pumps every mile for the sediment laden slurry pipeline flowing downstream. In addition, electrical or diesel gas power will be required for the operation of this alternative and will be significant.

Due to the geographically distributed nature of reservoirs, permanent pipeline and pump station infrastructure would be required for each reservoir.

Major environmental permitting issues are also anticipated, particularly for the intake and outfall locations. Power availability for the pump stations is also a concern that would need to be addressed if this alternative is pursued.

Two-Way Salt Water Pipeline – Performance

If the implementability concerns can be addressed, the conveyance capacity of the pipeline would not present performance concerns.

Two-Way Salt Water Pipeline – Cost

The cost of a two-way salt water pipeline including upstream and downstream piping and pump stations is expected to be approximately $400 million for each reservoir, and cost for operation and maintenance costs of the pipeline could be as high as $10 million. These costs do not include removing or placing sediment.

Two-Way Salt Water Pipeline – Conclusion

	Large reservoirs
	Small reservoirs
	Debris basins

Given the limitations on implementability and the extremely high cost, the use of two-way salt water pipeline as a transportation method is not considered as part of the this plan.

6.4.7 CABLE BUCKET SYSTEM

Cable Bucket System - General Description

Cable bucket systems have seen some use in large mining operations worldwide. They function similar to a ski gondola, with a bucket for sediment suspended from an overhead cable, supported by a series of towers.

Cable Bucket System - Environmental Impacts

Depending on the route considered, environmental impacts would be limited to the habitat disturbed due to construction of the support towers and loading and unloading areas.

Cable Bucket System - Social Impacts

The visual impacts associated with a cable bucket system are very high. Due to the complex initial setup, the system would be permanently installed, resulting in a permanent visual impact.

Cable Bucket System - Implementability

The ability to implement this system is limited mainly by the potential environmental permitting issues for constructing the support towers, which is highly dependent on the length and alignment of the route.

Cable bucket systems will require right-of-way acquisition. In addition, overhead limitations such as bridges and power lines may inhibit the use of cable bucket systems.

Because of the construction methods, cable bucket systems are considered permanent systems unlike conveyors that can be dissembled and moved.

Cable Bucket System - Performance

This alternative is expected to perform well, provided the considerable site logistics are addressed It shares many of the same performance characteristics as conveyor belts. As previously discussed, a conveyor belt system is estimated to move approximately 800,000 CY over a 6-month removal operation.

Cable Bucket System - Cost

The cost of a cable bucket system is expected to be $2,000 per linear foot. This cost does not include the cost of removing or placing of sediment.

Cable Bucket System – Conclusion

☒	Large reservoirs
☒	Small reservoirs
☒	Debris basins

Given the limited implementability and the expensive cost, the use of a cable bucket system as a transportation method will no longer be considered for future Flood Control District sediment removal projects.

6.5 PLACEMENT ALTERNATIVES

Section 6.5 describes locations considered for placement of sediment from future sediment removal projects. Specifically, this section discusses placement of sediment at solid waste landfills, pits, beaches, offshore, and sediment placement sites.

6.5.1 SOLID WASTE LANDFILLS

Some solid waste landfills use dirt to cover daily deposits of solid waste in order to avoid odors and other issues. This alternative considers delivering sediment from the Flood Control District's sediment management operations to solid waste landfills for daily cover purposes. The analysis was performed based on landfill operations as of 2012. However, it is important to note that landfill operations, including the quantity of sediment needed for daily cover and tipping fees, change over time.

In addition to discussing the general impacts of using sediment from the Flood Control District's sediment management operations as daily cover, this section provides details about a couple of the landfills in Los Angeles County, namely Sunshine Canyon Landfill and Scholl Canyon Landfill. Other landfills are not discussed due to their size, restrictions, impending closure (e.g., Puente Hills Landfill), or unknown future (e.g., Chiquita Canyon Landfill).

6.5.1.1 GENERAL

Solid Waste Landfills - Environmental & Social Impacts

It is assumed sediment deliveries from the Flood Control District would only be changing the source of the sediment used as daily cover and not the landfills' operations. Therefore, use of solid waste landfills for placement of sediment from reservoirs and debris basins would have minimal environmental and social impacts.

Solid Waste Landfills - Implementability

Landfill acceptance of sediment is constrained to their daily cover needs. The quantity and rate of removal from a cleanout activity must match that of the daily cover needs, unless a temporary sediment storage area can be utilized. Temporary storage areas could be located at the removal location, landfill, or another alternate location. Removal operations could also be altered to meet the daily cover needs.

Additionally, landfills have limitations on the maximum stone size and moisture content in sediment used for daily cover. This could limit the implementability of this alternative.

Sediment that is to be placed at a landfill may required testing to determine that it meets the requirements of that landfill.

Solid Waste Landfills - Performance

If sediment from various Flood Control District facilities needed a placement site at the same time and the quantity of sediment available is greater than the quantity that can be accepted by the landfills, a determination would have to be made as to what sediment would be taken to the landfills.

6.5.1.2 SUNSHINE CANYON LANDFILL

Sunshine Canyon Landfill, shown in Figure 6-12, is located at the northwestern end of the San Fernando Valley near the interchange of the 5 and 210 Freeways. As of 2012, the following conditions applied to the landfill.

- Currently the landfill uses approximately 2,000 CY of soil each day as cover.
- The landfill has adequate space to stockpile sediment. Therefore, delivery of sediment would not be constrained to the rate of daily cover needs.
- A tipping fee of approximately $7.50 per cubic yard or less would be assessed for sediment deliveries from the Flood Control District to offset the cost of rehandling stockpiled materials.
- The landfill would be interested in accepting sediment from the Flood Control District for daily cover purposes.

Figure 6-12 Sunshine Canyon Landfill Aerial

Sunshine Canyon Landfill – Performance

For planning purposes, it was assumed that approximately half of the landfill's daily cover needs could be reserved for sediment from the Flood Control District's sediment management operations. Based on this assumption, a total of approximately 20,000 CY of sediment could be delivered to Sunshine Canyon Landfill in a given month. This rate of acceptance will need to be compared with the rate at which sediment needs to be removed from a facility or a temporary sediment storage area.

Sunshine Canyon Landfill - Cost

As previously discussed, tipping fees at Sunshine Canyon Landfill are approximately $7.00 per cubic yard of sediment. This cost does not include the cost of removing or transporting sediment.

6.5.1.3 <u>SCHOLL CANYON LANDFILL</u>

Scholl Canyon Landfill, shown in Figure 6-13, is located in the City of Glendale just north of State Route 134. As of 2012, the following conditions applied to Scholl Landfill.

- Approximately 200 cubic yards of sediment are used at Scholl Canyon Landfill for cover each day.
- The landfill area has multiple areas for stockpiling material.
- The landfill does not accept dirt delivered on bottom dump trucks; therefore, sediment cannot be delivered to the landfill on double-dump trucks.
- A tipping fee of approximately $6.00 per cubic yard would be charged for clean dirt delivered.
- The landfill is currently interested in receiving clean dirt deliveries.
- Closure of the landfill is scheduled for 2024.

Figure 6-13 Scholl Canyon Landfill

Scholl Canyon Landfill – Performance

Assuming half of the landfill's daily cover needs could be reserved for sediment from the Flood Control District's sediment management operations, approximately 2,000 CY of sediment could be delivered to Scholl Canyon Landfill in a given month. This rate of acceptance is compared with the rate at which sediment would need to be removed from a facility or a temporary sediment storage area in the reservoir-specific sections.

Scholl Canyon Landfill - Cost

As previously discussed, tipping fees for clean dirt at Sunshine Canyon Landfill are approximately $6.00 per cubic yard. This cost does not include the cost of removing or transporting sediment.

6.5.1.4 SOLID WASTE LANDFILL SUMMARY & CONCLUSION

☑	Large reservoirs
☑	Small reservoirs
☑	Debris basins

The rate of acceptance of Sunshine Canyon Landfill and Scholl Canyon Landfill will be compared with the rate at which sediment would need to be removed from a facility or a temporary sediment storage area in the reservoir-specific sections. For the most part, this alternative alone cannot meet the sediment placement needs of the reservoirs and debris basins. If the entire removal quantity is too great for a landfill's need, this placement alternative could be a partial placement solution.

6.5.2 PITS

Pits – General Description

Pits include inert landfills, engineered fill operations, quarries (pits) that are currently being mined, and retired pits. Inert landfills are facilities that are are permitted to accept inert waste. Engineered fill operations must meet specifications prepared and certified for a specific project designed to act as a structural element.

As of February 2012, there was one permitted and active inert landfill in Los Angeles County and eight active engineered fill operations. Additionally, there are a number of pits that are currently being mined and several that have been retired, which could potentially accept sediment in the future. Most of the facilities are privately owned by aggregate industry businesses.

The majority of pits are available in the City of Irwindale area. There are a few pits located in the Sun Valley area and the City of Claremont, as seen in Figure 6-14. Due to the distance of the Claremont pits from the sediment management facilities and that large number of pits available in Irwindale area, the Claremont pits are not considered as part of this Strategic Plan. This section discusses the Irwindale Pits and Sun Valley Pits. Figure 6-15 shows an aerial image of some of the Irwindale Pits.

Figure 6-14 Location of Pits

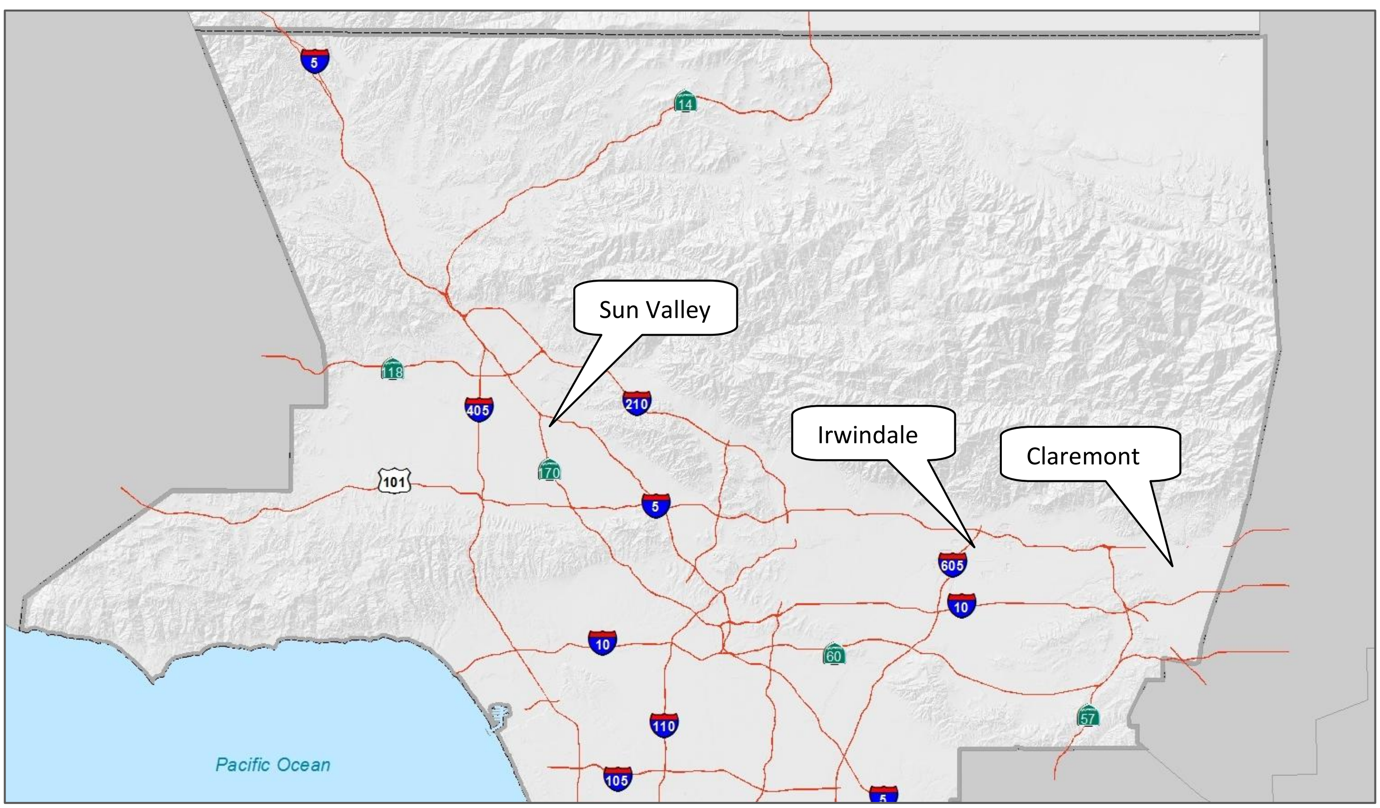


Figure 6-15 Pits in Irwindale Area

Pits – Assumptions

- Agreements can be developed with the gravel operator(s) for their acceptance of sediment from the Flood Control District.
- The gravel operator(s) have an ability to accept both marketable material for processing and sale as sand and aggregate, and non-marketable material for filling pits. Negotations would have to take place for how to value their acceptance of both types of material. For planning purposes, it is assumed they would accept marketable sediment along with an equal amount of non-marketable sediment free of charge.
- Material dredged or sluiced from the reservoirs would likely not be marketable due to the high concentration of fines in the material.
- The tipping fees of future inert landfill and engineered fill operations would be similar to the current tipping fees at the existing inert landfills and engineered fill operations.
- If the Flood Control District was able to acquire a pit for sediment placement, cost would be approximately $1 per cubic yard of available space. This cost is for the acquisition of property only.
- If the Flood Control District was able to acquire a pit for sediment placement, only the material that would not be accepted at the third-party pit free of charge would be taken to the Flood Control District pit for placement. The cost to place sediment at a Flood Control District pit would be approximately $2 per cubic yard. This cost is only for moving, placing, and grading sediment at the placement location

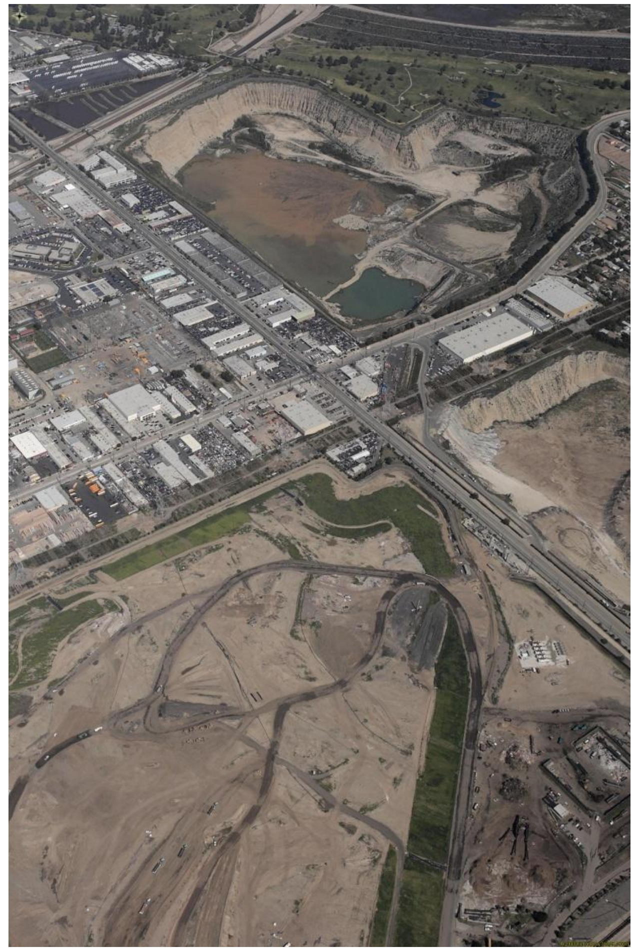
Pits - Environmental Impacts

Use of inert landfills, engineered fill operations, and pits for placement of sediment from reservoirs and debris basins would have minimal environmental impact because the sites are already disturbed.

Pits - Social Impacts

For the most part, depositing material in the pits would have minimal social impacts given the magnitude of the facilities and their existing uses. If transported by trucks, placing sediment at an inactive facility that is adjacent to residential neighborhoods would result in traffic and noise impacts. Freeway traffic in the region would also be impacted.

Figure 6-16 Pits in Sun Valley Area



Pits - Implementability

No agreement would be needed in order to deliver sediment to the inert landfills or engineered fill operations, unless the operator was willing to engage in a long-term agreement with the Flood Control District for the receipt of sediment at a reduced rate. Agreements would be needed in order to deliver sediment at the pits currently being mined or are still active. As of 2012, development of these agreements was being explored with the companies in the aggregate industry. The possibility of the Flood Control District acquiring retired pits for the purpose of sediment placement will be considered in more detail. The Sun Valley Pits are shown in Figure 6-16.

Pits - Performance

It was assumed that existing and future inert landfill and engineered fill operations would have the capacity to accept material at the rate at which it would need to be delivered for optimum sediment management operations at the reservoir and debris basins. Existing conveyors between some of the facilities could facilitate deliveries to the pits, if use of the conveyor belts can be arranged.

If sediment from several Flood Control District sediment management operations needed to be taken to the subject facilities at the same time and the sum of the quantities exceeded the maximum acceptable quantity, it would have to be determined which sediment to place at the pits.

Pits - Cost

As previously discussed, it is assumed that facilities operated by the gravel industry would accept marketable, high-quality sediment plus an equal amount of non-marketable material free of charge. It is assumed that for the remainder of the material, tipping fees would be as follows:

- Facilities in the Irwindale Area:
  - Single-dump trucks: $9.70 per cubic yard
  - Double-dump trucks: $7.00 per cubic yard
- Facilities in Sun Valley:
  - Single-dump trucks: $15.00 per cubic yard
  - Double-dump trucks: $10.00 per cubic yard

The estimated cost for the Flood Control District to acquire a pit is approximately $1 per cubic yard. Additionally, the cost to place sediment at the acquired pit would be approximately $2 per cubic yard. These costs do not include the cost of removing or transporting sediment.

Pits - Conclusion

☑	Reservoirs
☑	Small reservoirs
☑	Debris basins

Pits are a viable placement alternative for all facilities and the purchase and/or use will be pursued for future cleanout operations. In this Strategic Plan availability is assumed.

6.5.3 BEACHES

Beaches - General Description

Beaches are a potential placement location for sediment which could serve as beach nourishment and alleviate some of the concerns of erosion for Southern California beaches. However, a more feasible solution to the beach erosion issue exists in the sand reserves immediately offshore of Southern California. Use of the offshore sand would allow beaches to be replenished at a fraction of the cost of transporting from District facilities, and avoid a number of the issues identified below.

Figure 6-17 Sandy Beach

Beaches - Environmental Impacts

Beach nourishment would require consideration of environmental impacts to the area disturbed by placement activities. Air quality impacts would be unavoidable due to the long transportation distances involved. Water conservation impacts are not expected with the use of beach nourishment.

Beaches - Social Impacts

Beach nourishment would likely require sediment to be transported through several communities including those in the foothills and by the beaches. It would also affect noise, aesthetics, and recreational use of the beach during the placement activities.

Beaches - Implementability

Environmental permitting issues are expected to be a major hurdle for this placement option. Consideration must be given to color, angularity, size, and organic content of the sediment. This would require significant processing of the sediment because only about twenty percent of the sediment generated is appropriate for beach placement and the unacceptable material would need to be separated and transported to a disposal site.

Beaches - Performance

Beach nourishment would require a temporary storage location where the material could be processed and held until it would be able to be placed on the beach. In addition, since only a small percentage of the total sediment could be used for beach nourishment, this represents only a partial sediment placement solution if it is pursued.

Beaches - Cost

The cost to process and place sediment for beach nourishment would vary with the material from a specific location and the distance from that location to the placement beach. It is expected that the cost would be high.

Beaches - Conclusion

☒	Reservoirs
☒	Small reservoirs
☒	Debris basins

The use of beach nourishment as a placement location will be considered if other agencies approach the Flood Control District and are willing to share in the additional costs of processing, permitting, transporting, and placing the material.

Figure 6-18 Ocean for Offshore Placement

6.5.4 OFFSHORE

The U.S. Environmental Protection Agency and the Army Corps of Engineers have partnered for the operation of a number of offshore sediment placement sites. One of the off shore placement sites is located off San Pedro, as seen in Figure 6-18. This alternative is not feasible because current regulations prohibit use of offshore placement sites if onshore sites are available. In the case of sediment from Flood Control District facilities, there are many feasible options that would need to be exhausted prior to investigating offshore placement.

Further, the transport distance to the port is more than double that of other placement locations. Additional costs would also result from double-handing material to transfer it to a barge, then transport the material offshore to the disposal site.

Offshore Placement - Conclusion

☒	Reservoirs
☒	Small reservoirs
☒	Debris basins

For these reasons, offshore placement will not be considered as a placement location for future Flood Control District sediment removal projects.

6.5.5 SEDIMENT PLACEMENT SITES

As discussed in Section 2.4, sediment placement sites (SPSs) are sites developed by the Flood Control District throughout the County to be strategically filled with sediment resulting from the cleanout of facilities such as reservoirs and debris basins. This section discusses placement at previously used SPSs and at potential new SPSs.

Figure 6-19 Dunsmuir SPS

6.5.5.1 PREVIOUSLY USED SEDIMENT PLACEMENT SITES

As described in Section 2.4, the Flood Control District owns 36 SPSs. Of these, 17 sites that are considered active have a combined estimated remaining capacity of approximately 48 MCY. One site in particular, Burro Canyon SPS, has a remaining capacity of approximately 29 MCY, accounting for the bulk of the remaining capacity at all sites. These facilities will continue to be used as part of the Flood Control District's sediment management operations until other placement alternatives have been fully analyzed and developed for use. As a result, this alternative is not compared with the other placement alternatives considered by the Sediment Management Strategic Plan unless the site is needed for future placement.

6.5.5.2 POTENTIAL NEW SEDIMENT PLACEMENT SITES

While it is understood that there are environmental concerns associated with the development of new SPSs, this alternative is still being considered as part of this Sediment Management Strategic Plan. The reason for this being that a new sediment placement site and transportation of sediment to it could have fewer impacts than placing and transporting sediment to another placement alternative that is farther away. The uses of specific sediment placement sites are explored further with placement options for various facilities in Sections 7 through 10.

6.5.5.3 SEDIMENT PLACEMENT SITES SUMMARY & CONCLUSION

☑	Reservoirs

☑	Small reservoirs
☑	Debris basins

SPSs are a viable placement alternative for all facilities. Previously used SPSs will continue to be used until other placement alternatives have been fully analyzed and developed for use. Potential new SPSs will continue to be considered in cases where impacts could be less than other alternatives.

6.6 SEDIMENT PROCESSING

Sediment deposits in reservoirs and debris basins under the Flood Control District's jurisdiction are composed of a wide range of sediment types, including silts and large boulders. In order to utilize these sediment deposits as sources of useful materials, the sediment deposits must be processed to produce materials of specific grain size and gradations.

Figure 6-20 Sediment Processing Plant in the Irwindale Area.

A soils investigation of the sediment in representative dams and debris basins indicates that a portion of these deposits have commercial value and can be processed into useful construction materials to broadly include:

- Coarse Aggregate
- Washed Concrete Sand
- Aggregate Base
- Fill Sand
- Top Soil

The net value of materials, considering processing costs but no handling at the source or transportation, is estimated at about $1.30 per cubic yard for average materials derived from debris basins or reservoirs. Depending on the distance from sediment source to processing location, the net value of these materials could easily be exceeded by the cost of transporting materials to a production plant for processing. However, transportation costs are generally unavoidable when excavating sediment from a debris basin or reservoir, whether the excavated materials are transported to a production plant for processing into useful materials, or to a location for final disposition such as an SPS, landfill, or pit. Any gains achievable from producing construction materials would help offset costs associated with cleaning out debris basins or reservoirs. The indirect value of diverting sediment from existing SPSs and pits and thereby extending the service life of these facilities is also a significant benefit. Aggregate industry companies or other appropriate soil brokers will handle materials processing at their facilities.

Based on the results of the field explorations, laboratory testing and economic analyses, the following conclusions are presented.

Major Findings:

- Materials accumulating in debris basins or reservoirs have commercial value, when processed into construction materials, which could offset some of the cost of cleaning out these facilities.
- In addition, the service life of existing SPSs and pits could be extended by diverting material from these disposal sites to useful applications.

Other Findings:

- Because of the low value of top soil with respect to the production cost and the amount of waste associated with materials containing more than 70 percent fines, processing low quality materials should be avoided.
- Inclusion of washed wand in the final mix of products generally results in an overall higher valuation, however, washed wand does not provide a significant higher valuation compared to fill sand due to the relatively small gain in value with respect to the increased cost of waste disposal.
- Although fill sand could have similar net valuation compared to washed sand due to waste disposal costs, there may not be sufficient demand to keep up with production, and substantial stockpiling could be necessary.

6.7 SUMMARY

A number of alternatives were considered for sediment management at large reservoirs, small reservoirs, and debris basins. However, only some are feasible for the sediment management needs of the Flood Control District.

The alternatives identified to be feasible in this section are considered specifically for each reservoir and the debris basins in Sections 7 through 10. In those sections, location specific impacts and quantity specific costs are presented. Additionally, the alternatives are joined to form combined alternatives that address the entire sediment management process and planning quantities for the specific facilities.

Table 6-2 provides a summary of the alternatives for each general category of facility. Those that have been removed from consideration for that category of facility have been shaded out.

Table 6-2 Alternative Feasibility Summary

All Alternatives Considered	Large Reservoirs	Small Reservoirs	Debris Basins
Removal Methods	**Removal**	**Removal**	**Removal**
Dry Excavation	Dry Excavation	Dry Excavation	Dry Excavation
Dredging	Dredging	Dredging	Dredging
Sluicing	Sluicing	Sluicing	Sluicing
Transport Methods	**Transport**	**Transport**	**Transport**
Sluicing	Sluicing	Sluicing	Sluicing
Flow Assisted Sediment Transport	FAST	FAST	FAST
Trucking	Trucking	Trucking	Trucking

Trucking in Channels	Trucking in Channels	Trucking in Channels	Trucking in Channels
Conveyor Belts	Conveyor Belts	Conveyor Belts	Conveyor Belts
Slurry Pipeline	Slurry Pipeline	Slurry Pipeline	Slurry Pipeline
Rail Lines	Rail	Rail	Rail
Two-way Saltwater Pipeline	Saltwater Pipeline	Saltwater Pipeline	Saltwater Pipeline
Cable-Bucket Systems	Cable-Bucket	Cable-Bucket	Cable-Bucket
Placement Locations	Location	Location	Location
Landfills	Landfills	Landfills	Landfills
Pits	Pits	Pits	Pits
Beach Nourishment	Beach	Beach	Beach
Offshore Placement	Offshore	Offshore	Offshore
Sediment Placement Sites (SPSs)	SPSs	SPSs	SPSs

Gray boxes indicate alternatives no longer considered for the listed facility type.